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DOD Space Programs Presented to the National Security Council
7 November 1960

Mr. President:

It is the purpose of this briefing to describe for you the present status of and future outlook for our DOD space programs. I will also outline the manner in which the NASA and the Department of Defense are coordinating their efforts in space. Chart #2 shows the principal space programs in the Department of Defense and a few in NASA, spanning the time period from 1957 through the middle of the 1960 to 1970 decade. These are the DOD approved programs. The DISCOVERER basic research and development program, plus three for military missions, SAMOS for reconnaissance; MIDAS for early warning; the SAINT system for interception and inspection of satellites and two for the support of military missions, TRANSIT for navigation and ADVENT for communications. In addition, there are the TIROS meteorology satellites for NASA, in which the Defense Department has a considerable collateral interest, the MERCURY man-in-space program of the NASA which is supported also by the Department of Defense and a number of scientific programs undertaken by the NASA for the exploration of the space environment with which the Department of Defense also cooperates. I will not discuss today the NASA programs; only the approved programs of the Department of Defense shown on Chart #3.

First, the DISCOVERER which provides the development of basic techniques for utilization by the SAMOS and the MIDAS and then SAMOS, MIDAS, TRANSIT, ADVENT, and SAINT.

Chart #4 shows the DISCOVERER program which has as its objective the research and development on components, equipment, instrumentation, propulsion and the like. One of the principal objectives of the DISCOVERER has been to develop the capability of recovering a capsule ejected from orbit. The AGENA vehicle which is placed into orbit by a THOR booster for the DISCOVERER launch will be the principal vehicle for both the SAMOS and the MIDAS satellites and is one of the principal development objectives for the research and development program that's carried out here. The AGENA vehicle has the capability of remaining in a position fixed with respect to the earth, that is, it can continue to look down at the earth as the vehicle goes around the earth. There have been a total of ten successful launchings of the DISCOVERER satellite, by successful we mean the propulsion system worked, the guidance system worked, the commands from the ground which were received by the AGENA vehicle caused a response, but it does not mean that all ten of these launchings were completely successful. There have been a total of 16 launches of the DISCOVERER satellite, number 13 was the first one to have been recovered, it was not snatched in the air, but was recovered at sea. Number 14 was recovered in the air; number 15 was successfully ejected and sighted, but not recovered and number 16 failed.

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Number 17 is planned for launch on the 9th of November.

There are scheduled a series of DISCOVERER launchings at approximately the rate of one every two weeks for the better part of 1961. A total of about 222 million dollars was invested in the DISCOVERER program in FY 60 and before, 55 million in FY 61, and only about 15 million will be necessary in FY 62 to complete this program.

The SAMOS program outlined on Chart #5 has as its objective the development of a reconnaissance satellite system. A development program and a revised program philosphy with respect to SAMOS was presented to you, Mr. President on the 25th of August, at the NSC meeting at which time certain program changes were authorized. These included the emphasis of recovery over read-out continuing with recovery over water but with effort directed toward eventual land recovery; and of photography emphasis over ferret. A total of 22 shots is presently scheduled on the SAMOS program through 1962. The first six of these shots will be read-out---they will be read-out because they were already planned and the bulk of the equipment had already been purchased before the reorientation that was accomplished at the end of the 25th of August. Of the remaining shots, 14 are recovery and 2 are diagnostic shots. A total of 353 million dollars has been invested in the SAMOS program in FY 60 and before, about [redacted] is presently programmed for FY 61 and we are presently planning approximately [redacted] for FY 62. This makes a total of more than [redacted] dollars for the SAMOS program, all of which is planned for the research and development phase at the present time. The SAMOS project is being managed by the Secretary of the Air Force in a management arrangement that gives particular emphasis to SAMOS which is being handled as a program of the highest urgency in priority.

The MIDAS program outlined on Chart #6 has as its objective, the development of a missile defense alarm system. It is essentially a feasibility program to determine whether or not one actually can accomplish, from a technological and economic view, a warning system based on satellite reconnaissance. The system depends primarily on the scanning eye - the infra-red scanning eye in the satellite itself. As the MIDAS travels over the surface of the earth at an altitude of about 2000 miles, it looks down, the infra-red sensors pick-up signals from the launching of missiles because of the infra-red radiation from the rocket plume. There are a number of technical problems associated with this device. Reflections from the sun from clouds that extend to high altitudes would also introduce signals into the scanning eye. Would the MIDAS be able to tell cloud reflections from missile plumes? Perhaps it would if we were able to distinguish moving targets from stationary targets but that would take computation and data processing...how would we accomplish that? These are among the kinds of technical questions that presently require solution and for which answers are being sought in conducting the MIDAS program. If one were to put eight MIDAS satellites with a station keeping capability into polar orbits four in each of two 90° opposed polar orbits, and with appropriately located for north ground read-out stations, it would be possible to keep the sino-Soviet block under surveillance at all times. It would not be possible to cover all the ocean areas with only eight satellites in these orbits, it would be necessary to have more than that number of satellites and additional ground stations in order to do that. If one had eight satellites in orbit this way, it would provide an additional approximately 15 minute maximum warning over the BMEWS for missiles that are launched in Russia against the continental United States. It would give less than 15 minute warning from missiles which are launched from the ocean areas since those missiles would arrive sooner...would have a shorter time to fly. What is needed on this program is more shots and more data. There were two early this year, neither of them completely successful. The first one didn't get into orbit and in the second one, the communications system failed and very little data were received back. We are hoping that before the scheduled MIDAS III launch in February 1961 we can interject two THOR boosted infra-red payloads for the acquisition of additional data that are not in the program schedule shown on the chart. A total of 188.5 million dollars was invested in MIDAS in 1961 and before, FY 62 presently calls for approximately 200 million dollars. Including the FY 63 estimate of 75 million dollars, the total will be approximately 463 million dollars, according to present estimates for the research and development program. Estimates on a program of this sort are very difficult to make. Were one to put eight satellites into operation in this manner it is presently estimated that it would cost about 500 million dollars to get the system into operation in the first place, and between 100 and 400 million dollars a year to keep them there in operational use, depending on the degree of reliability or mean time to failure.

Chart #7 shows TRANSIT, the navigational satellite, a program aimed at developing an all weather, accurate navigation system. TRANSIT has been one of the most successful of the DOD space programs to date, also, one of the most economical. It consists of a satellite which is placed in orbit with a four channel radio broadcasting arrangement. Antennas from the ground track the satellite as it passes overhead and radio to the satellite very accurate information concerning what time it is and exactly where the satellite is located. In this way, slight perturbations in the orbit of the satellite are known by the satellite and can be rebroadcasted as the satellite goes around the world. A ship at sea, for example, can interrogate the satellite and with special receiving and computing equipment can find out exactly at what time it is receiving signals from the satellite and precisely what the parameters or characteristics of the satellite orbit are. In this way, and by observing the Doppler shift, that is, the apparent change in the frequency of the radio signals coming from the satellite as it passes by, it is possible for the ship to get information which enables it to locate itself with a high degree of accuracy. As a matter of fact, the accuracy with which a ship at sea or someone on land with the proper receiving equipment can locate himself is in the neighborhood of 1/10 of a mile. Without some of the special equipment associated with the military operational system it is still possible to receive the signals from the TRANSIT and to locate your position between somewhere 1/4 and 1/2 a mile. The TRANSIT also has some attractive features from the standpoint of potential command and control system. One might imagine, for example, a number of transmitters would be able to broadcast a coded signal to the TRANSIT, which it in turn could rebroadcast so that as these radio signals are picked up by ships at sea they would now know that the United States was not under attack. One could also imagine broadcasting the appropriate alert level warning signals or even attack signals to the TRANSIT thus combining both a navigation and a highly invunerable communications system in one package. About the only thing that prevents the TRANSIT from being made a fully operational system at the present time, is reliability or the state of the art which prevents us from putting satellites into orbit with the degree of reliability and lifetime that enables us to make a highly economical operation with them. There have been three research and development TRANSIT satellites launched so far, there is one more scheduled before the end of this year, and two in 1961. Only about 20 million dollars has been invested in this program in FY 60 and before, 21 million dollars in FY 61 and we are planning for 17 in FY 62.

The ADVENT program shown on Chart #8 is part of the communications satellite development effort in the Department of Defense. It has as its objective the development of a repeater type communications satellite system. Communications satellites are one of the most attractive applications of space technology that we are working on today. It looks as if really large gains, really substantial gains, in communications capability will be accomplished through the use of communications satellites either active or passive. ADVENT is what is called an active communications system. That is it is a relay station which instead of being located on the ground is located in space. Signals are transmitted from the ground to this relay station and rebroadcast to another location which in the case of ADVENT can be on another continent. ADVENT is planned to orbit at 19 to 20 thousand miles above the surface of the earth in a so-called synchronous equatorial orbit, that is, it rotates at the same rate as the earth and in the same direction and appears to hover over a fixed point on earth. With three satellites in an equatorial plane and in a synchronous orbit, equally spaced with respect to each other, it is possible to cover about 80 or 90 percent of the earth with an inter-global communications system. The capacity of the ADVENT system is also very considerable. There would be somewhere between, depending on how it's configured, ten to forty megacycles of bandwidth available for communications. This is between 10 and 40 times the amount of reliable bandwidth (meaning cables) presently available to the United States for communication to all places outside of the continent of the United States. It is almost half as much as the total bandwidth available for communication between the East Coast of the United States and the West Coast of the United States. There are a number of problems associated with the ADVENT system. One of the problems is getting it into position in the first place. This requires considerable complexity in launching; it requires continually steering the satellite once it is in position in order to keep it there; it is necessary to keep it pointing accurately at the earth because these antennas which are looking down at the earth have comparatively sharp beams and must continue to point in the right place, and, of course, there is the problem of reliability, because putting this satellite into orbit is an expensive thing to do. There is roughly a thousand pounds of equipment aboard. It is difficult but necessary to make this equipment reliable in order to make the operation economical. The first launchings for ADVENT are not scheduled until 1962. There are a series of these--the first three shots labeled "B" use the ATLAS-AGENA B and the ones labeled "C" are to be accomplished with an ATLAS-CENTAUR which is an advanced type booster involving a hydrogen-oxygen upper stage being developed by NASA. Twenty-five million dollars have been invested in this program in FY 60 and before and 42 million dollars in FY 61. We are considering more than 60 million dollars in FY 62. The total presently estimated for the demonstration and feasibility of ADVENT through FY 64 is 174 million dollars, but this is undoubtedly a low estimate.

While on the subject of communications, I would like to describe WEST FORD--WEST FORD is not a complete project in the same context as the others I've described. ADVENT is an approved project--WEST FORD is an experiment. Formerly it was called NEEDLES. This experiment is being conducted by the Department of Defense on the basis of an express understanding with NASA that this particular passive satellite experiment should properly be undertaken by us. It consists of a donut shaped reflector placed in orbit about 2000 miles above the earth in essentially a polar orbit. This is not a solid donut, it consists of about a billion little particles of metal, little wires that are approximately the length of a postage stamp or about two centimeters long and they are about 1/3 the thickness of a human hair. Actually they should be visualized as a very, very fluffy cloud. The spacing between these little dipoles is in the order of 500 to 1000 feet. But, nevertheless, when these approximately billion dipoles have been placed into an orbit of this kind they do form a very good reflector for radio waves in a certain frequency band. Thus, it is possible for a transmitter located in the United States, for example, to bounce signals off of this donut shaped reflector and have them received at intercontinental distances. This would comprise then a microwave link. It has a number of advantages if it works. One advantage is that two such belts, one in an equatorial orbit and one in a polar orbit would enable you to have microwave communications throughout the entire world. It is absolutely involnerable to any kind of enemy action. It would be impossible for any potential enemy to sweep this out of the sky. It can be designed to have very long life. It is belived that one could put this kind of a reflector into orbit and have it last there in the order of ten years, and it does not require antennas that have to track very much. That is, if you are looking at those portions of this reflector which are close to the pole as the earth rotates, the rotation there is very slight, the rotation of the Pole itself is zero, it is not necessary to have much motion of the antennas on the ground whereas in the case of the ECHO balloon, for example, it is necessary to follow with fairly complex antennas. It should be pointed out that this experiment is being conducted in accordance with guidance which was provided by the Operations Coordinating Board on the 10th of August 1960. The experiment is designed so that it will not last more than approximately from nine months to one year at which time the radiation pressure of the sun will have driven these particles close enough to the earth so that they will be burned up by the earth's atmosphere. People have wondered whether this cloud of particles would interfer with radio astronomy. The answer to that is that all calculations indicate it will not. Will it interfere with optical astronomy by reflecting sunlight from the particles? Again the answer is that it is not believed that it will. Will this cloud be a danger to other satellites which might be launched and passed through it? The answer is that the density of the particles in this cloud is no greater than the density of micro-meteorites in this area of space generally.

I might also mention the utilization of the moon as a relay by the Navy for communication purposes. It demonstrates the feasibility of bouncing signals off of satellites in space. This moon relay has been in operation for a period of approximately two years on an average of about five hours a day, three days a week. It has provided reliable communications. There are four channels of sixty word per minute teletype capacity which are in use using the moon relay. There are 84 foot transmitting and receiving dishes on this coast and similar 84 foot dishes in Honolulu, Hawaii, which send and receive the signals. Last Sunday this moon relay was the only reliable radio communication between the East Coast of the United States and the Hawaiian Islands.

Chart #9 summarizes SAINT which is a program which has been very recently approved for the development of a satellite inspection system. It is a rendezvous satellite intended to intercept, to inspect and potentially to neutralize satellite vehicles. Its specific objective is to develop and to demonstrate the capability of coming within fifty feet of a orbiting vehicle and passing that orbiting vehicle at a speed no greater than one foot per second which is the speed of a very, very slow walk. It is believed that once a capability such as this is achieved, the destruction of a satellite with which one is rendezvousing would be very easily undertaken, but no experiments involving the destruction of another satellite are contemplated without specific Presidential approval. Coming this close to a satellite it would be possible to take pictures of it, to radio these pictures back to earth, to sense whether or not there is radio-activity on board and so forth. A contract will be awarded for this program late this year. A series of four launches are planned. It is expected it will cost about 62 million dollars to complete this demonstration.

I would like to summarize now the remarks I have made so far and return for a moment to Chart #2. First, with respect to the programs which are the approved space programs in the Department of Defense. It may be noted that the first ATLAS missile was launched in 1957. The first American satellite was launched in the early part of 1958 and yet in the last three years all of these activities have come to their present point. In 1957 and prior years, about 95 million dollars had been invested in space programs exclusive of the large boosters and other space elements associated with the Ballistic Missile

Program. In the subsequent years, approximately 118 in FY 58, 399 in FY 59 and 392 in FY 60. This is less in FY 60 than in FY 59 because of the transfer of space programs including the SATURN to the NASA but in FY 61, 532 million dollars have been devoted to space programs in the Department of Defense. If you add the total cost of the programs I've discussed for FY 62, they add up to approximately 600 million dollars. If you add to these programs the total of all efforts in the Department of Defense which are related to space, it adds up to somewhere in the neighborhood of 800 to 900 million dollars for FY 62. If one includes certain other projects which are sometimes counted as space projects and sometimes not, such as DYNOSOAR, this total will be more than 900 million dollars, it could be in the order of 1 to 1.2 billion dollars. The totality of the space efforts of the NASA and the DOD in FY 61 is about 1 and 1/2 billion dollars. The totality of the NASA and DOD efforts in space, and I am not counting the work that is related to the research and development for large missiles per se, although many of the techniques are applicable to space programs, the total in FY 62 of NASA and the DOD together will be somewhere between 2 and 2½ billion dollars. This is based upon present budget estimates of course. I have not described the NASA component of this effort nor have I described the substantial growth in the collateral efforts in the Department of Defense which are not part of these approved programs.

I would like next to discuss the management arrangements which the Department of Defense has with NASA for undertaking our projects jointly. The question we are confronted with is how can the Department of Defense and NASA undertake a joint effort in space, that is todays' problem with respect to a great many details of our space programs; how can we both today and tomorrow provide policy direction which will keep pace with technological problems.

This spring, the Department of Defense and NASA jointly formed the NASA-DOD Aeronautics and Astronautics Coordinating Board, the structure of which is outlined on Chart #10. The Co-chairman of this Board are Dr. Hugh Dryden, and Dr. Herbert York. The Board has ten members, six of the members are the chairman of panels which are subsidiary to the Board, two of the members are the Co-Chairman of the Board and there are two members at large for a total of ten. The six panels of the Board cover major fields related to those areas in which the NASA and the DOD have programs of common interest. Manned space flight, unmanned spacecraft, launch vehicles, space ground environment, supporting space research and technology and aeronautics. Each of these panels has eight members; four from the Department of Defense and four from the NASA. The chairman of each of these is chosen either from NASA or DOD. The vice chairman then comes from the agency which does not hold the Chairmanship. Membership on these panels is chosen from people who have authority and responsibility within their respective agencies. It is expected that these panels then, will not serve merely as committees but will serve as action agencies to develop and to coordinate and to implement the plans and programs jointly agreed upon between NASA and the DOD through this management mechanism. Several meetings of the Coordinating Board have been held since this spring. Some of these panels have become very active just during the last few months. A great many boards and panels have been eliminated as a result of this mechanism and some have been absorbed within this structure. Among the things which have been accomplished has been improved coordination and the development of policy between NASA and DOD with respect to how passive and active satellite programs will be undertaken between them. The geodetic satellite which was to have been undertaken by NASA, it has been agreed, will be undertaken by the Department of Defense and it has been agreed that the three services will share responsibility for this project. All of this has been accomplished within a very few weeks time and some of the major decisions just a few days time through the activity of the Unmanned Spacecraft Panel. Facilities in the area of ground environment which include ranges, launching facilities and the allocation of booster for space programs used both by the Department of Defense and by the NASA have been coordinated on an ever improved basis through this Space Ground Environment Panel through the office of General Yates, who is Deputy Director of Defense Research and Engineering for Ranges and Space Ground Support.

In closing, I should like to note that in the past twenty years, the Federal expenditures for research and development have expanded by a factor of between 50 and 100 times. During the last three years, since the launching of the first ATLAS and the launching of the first American satellite, expenditures for research and development, test and engineering in space have risen to the point where today between 1/3 and 1/2 of all Federal expenditures for research and development are for the large missile and space programs. The combined efforts of NASA and the DOD; the combined budget of NASA and the DOD for space next year, in fiscal year 1962, is likely to be equal to the sum of the research, development, test and engineering budgets of the Army and the Navy put together. The division of effort between NASA and the DOD is going to be of continuing importance, in all probability it will be of growing importance in the years to come. Planning for major space efforts, some of which, such as exploring the moon, could cost tens of billions of dollars, must be done very carefully, must be done competently and must be done in a context of overall national policy. The existing mechanisms for planning and coordination are working well, but they will require continuing review and they will undoubtedly be revised as the future unfolds, and finally, continued top level policy guidance and support will be of increasing importance as space technology expands and evolves. Thank you Mr. President.